

Patent Claims

1. A method for testing at least one antenna (2) having a receiver module (8) and a coupling module (10) which is arranged between the at least one antenna (2) and the receiver module (8), in which the antenna (2) and the receiver module (8) are supplied by means of the coupling module (10) with a noise signal (S) from at least one noise signal source (18) as a test signal, with an instantaneous transmission coefficient (\ddot{U}_v), which indicates the ratio between a first noise signal (which is passed to the test module (12) via a first path (S, S_1) without passing through the at least one antenna (2)) and a second noise signal (which is passed to the test module (12) from the noise source (18) via a second path (S', S_2) which passes via the at least one antenna (2)) being determined, and being compared with a reference transmission coefficient ($\ddot{U}_{v\text{inorm}}$), which is stored in a transmission matrix (14), by means of a test module (12).

2. The method as claimed in claim 1, in which an uncalibrated noise source is used as the at least one noise source (18).

3. The method as claimed in claim 2, in which switching takes place between the first path (S_1) and the second path (S_2) by means of a switchable coupling circuit (44) by means of which the noise signal is injected into the first and second paths (S_1 , S_2) respectively, such that the noise signal is passed directly to the receiver (8) via the first path (S_1), while a noise signal which has been reflected from the at least one antenna (2) is superimposed on the noise signal and is passed to the receiver (8) via the second path (S_2), and the second noise signal is detected on the basis of the transmission matrix, and is compared with the frequency characteristic of the first noise

signal.

4. The method as claimed in claim 2, in which a
switchable coupling circuit (44), by means of which the
5 noise signal is injected into the first and second
paths (S_1 , S_2), and in which the noise signal which is
reflected at the at least one antenna (2) has the noise
signal superimposed on it on an impedance (Z), switches
between the first path (S_1) and the second path (S_2)
10 such that the noise signal is passed directly to the
receiver (8) via the first path (S_1), while a noise
signal which has been reflected from the at least one
antenna (2) is superimposed on the noise signal and is
passed to the receiver (8) via the second path (S_2),
15 and the second noise signal is detected on the basis of
the transmission matrix, and is compared with the
frequency characteristic of the first noise signal.

5. The method as claimed in claim 2, in which a
20 directional coupling network (48) with a switchable
signal flow direction, by means of which the noise
signal is injected into the first path or second path
(S_1 , S_2), switches between the first path (S_1) and the
second path (S_2) such that the noise signal from the
25 noise source (18) is made available as the first noise
signal, and the noise signal (S_2), which is being
reflected on the antenna (2) is made available as the
second noise signal, for evaluation at the receiver
(8).

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6. The method as claimed in claim 5, in which the
switching between the first path (S_1) and the second
path (S_2) is carried out by means of an additional
switching device (49) in the first path (S_1) and a
35 switchable amplifier in the second path (S_2), instead
of being carried out at the inputs of the directional
coupling network (48).

7. The method as claimed in claim 1, in which a calibrated noise source whose frequency characteristic is known is used as the at least one noise source (18) a superimposition of the first and second noise signals is supplied to the test module (12) and is in the form of a typical frequency characteristic, and the typical frequency characteristic is compared with the known frequency characteristic of the calibrated noise source.

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8. The method as claimed in one of claims 1 to 7, having an additional antenna which has no connection for the receiver module (8) and into which the noise signal (S) is injected, and which sends this noise signal (S) as a test signal to the at least one antenna (2).

9. The method as claimed in one of claims 1 to 8, in which, in the case of a multiple antenna system (4) which has two or more antennas (2), a noise signal (S_2) which has been reflected at each of the individual antennas (2), and/or a noise signal (S' , S_2) which has been transmitted between the antennas (2) are/is evaluated as the second noise signal.

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10. The method as claimed in one of claims 1 to 9, in which the transmission coefficient (\ddot{U}_v) and the reference transmission coefficient ($\ddot{U}_{v\text{norm}}$) are determined by means of a frequency analysis and/or level analysis.

11. An arrangement (1) for testing at least one antenna (2) having a receiver module (8) and a coupling module (10) which is arranged between the at least one antenna (2) and the receiver module (8), in which the coupling module (10) is provided to inject a noise signal (S) from at least one noise source (18) into the at least one antenna (2) and into the receiver module

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(8), as well as a test module (12) for determination of an instantaneous transmission coefficient (\ddot{U}_v), which indicates the ratio between a first noise signal (which is passed to the test module (12) via a first path (S, S₁) without passing through the at least one antenna (2)) and a second noise signal (which is passed to the test module (12) from the noise source (18) via a second path (S', S₂) which passes via the at least one antenna (2)) being determined, and is provided for comparison of the instantaneous transmission coefficient (\ddot{U}_{v1}) with a reference transmission coefficient (\ddot{U}_{vinorm}) which is stored in a transmission matrix (14).

12. The arrangement as claimed in claim 11, in which the at least one noise source (18) is an uncalibrated noise source.

13. The arrangement as claimed in claim 12, furthermore having a switchable coupling circuit (44) by means of which the noise signal can be injected into the first and/or second path (S₁, S₂), for switching between the first path (S₁) and the second path (S₂), such that noise signal can be supplied directly to the receiver (8) via the first path (S₁) while the noise signal which is being reflected from the at least one antenna (2) and is superimposed on the noise signal can be supplied to the receiver (8) via the second path (S₂) with the test module (12) detecting the second noise signal on the basis of the transmission matrix, and comparing it with the frequency characteristic of the first noise signal.

14. The arrangement as claimed in claim 12, furthermore having a switchable coupling circuit (44) by means of which the noise signal can be injected into the first or second path (S₁, S₂) and in which the noise signal which has been reflected at the at least one

antenna (2) can be superimposed on the noise signal in an impedance (Z), for switching between the first path (S_1) and the second path (S_2), such that the noise signal can be supplied directly to the receiver (8) via the first path (S_1) while the noise signal which is being reflected from the at least one antenna (2) and is superimposed on the noise signal can be supplied to the receiver (8) via the second path (S_2) with the test module (12) detecting the second noise signal on the basis of the transmission matrix, and comparing it with the frequency characteristic of the first noise signal.

15. The arrangement as claimed in claim 12, furthermore having a directional coupling network (48) with a switchable signal flow direction, by means of which the noise signal can be injected into the first or second path (S_1 , S_2), for switching between the first path (S_1) and the second path (S_2), such that the noise signal from the noise source (18) is made available as the first noise signal, and the noise signal (S_2), which is being reflected on the antenna (2) is made available as the second noise signal, for evaluation at the test module (12).

16. The arrangement as claimed in claim 15, in which an additional switching device (49) is formed in the first path (S_1) and a switchable amplifier is formed in the second path (S_2), by means of which it is possible to switch between the first path (S_1) and the second path (S_2) instead of to the inputs of the directional coupling network (48).

17. The arrangement as claimed in claim 11, in which the at least one noise source (18) is a calibrated noise source whose frequency characteristic is known.

18. The arrangement as claimed in claim 17, in which the noise signal can be injected by means of a coupling

network (24) into the path from the at least one antenna (2) to the test module (12), such that the first and the second noise signal ($S_1 + S_2$) are superimposed, with the superimposition resulting in a
5 typical frequency characteristic, and in which the test module (12) compares the typical frequency characteristic with the known frequency characteristic of the calibrated noise source.

10 19. The arrangement as claimed in claim 17, in which the noise signal can be injected by means of a directional coupling circuit (46) into the path from the at least one antenna (2) to the test module (12), such that only the second noise signal (S_2) is
15 detected, and the test module (12) compares the typical frequency characteristic resulting from the second noise signal with the known frequency characteristic of the calibrated noise source.

20 20. The arrangement as claimed in one of claims 11 to 19, furthermore having an additional antenna which has no connection for the receiver module (8), for sending the noise signal (S) as a test signal to the at least one antenna (2), with the coupling module (10)
25 injecting the noise signal (S) into the additional antenna.

21. The arrangement as claimed in one of claims 11 to 20, in which the coupling module (10) has at least one
30 RF switch (20) for connection of the at least one antenna (2).

22. The arrangement as claimed in one of claims 11 to 21, in which the transmission matrix (14) in the case
35 of a multiple antenna system (4) comprises a number of transmitting antennas ($2(n)$) and receiving antennas ($2(m)$) as antenna pairs ($2(n, m)$) which correspond to the number of antennas (2).